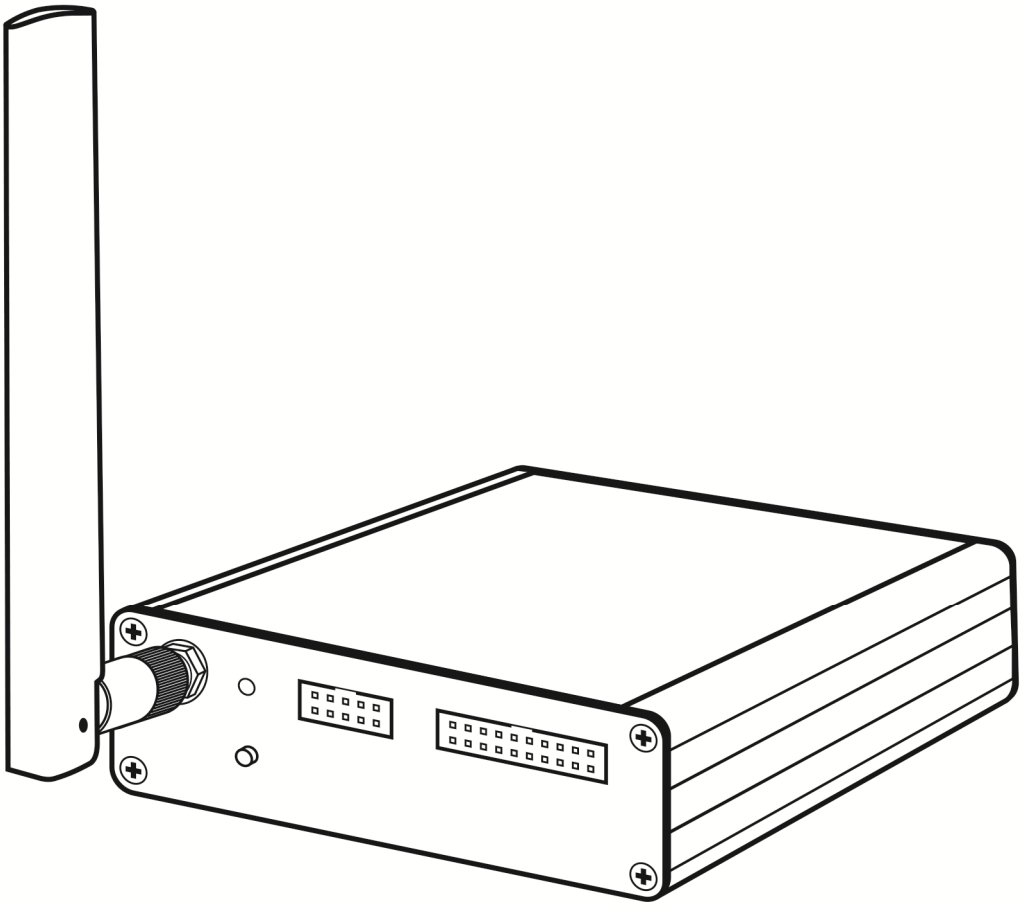
WIRELESS REMOTE DEBUGGER

WRD/Probe

With LTE-M Modem



Hardware Reference

SSV SOFTWARE SYSTEMS

Document Revision 1.1 // 2026-03-02

CONTENT

1 INTRODUCTION

This document describes the basic hardware components of the WRD/Probe Wireless Remote Debugger.

The battery-operated WRD/Probe offers up to 12 months of battery life without recharging. It connects automatically with LTE-M to a development environment (IDE) via a rendezvous service (WRD Services) over the Internet.

This creates a “virtual debug cable”. It integrates seamlessly into your familiar IDE such as VSCode or Eclipse. Starting the build process, setting a breakpoint, inspecting variables etc. remains the same.

The WRD/Probe connects to your workstation via an encrypted end-to-end tunnel established with an out-of-band pairing with a flicker code.

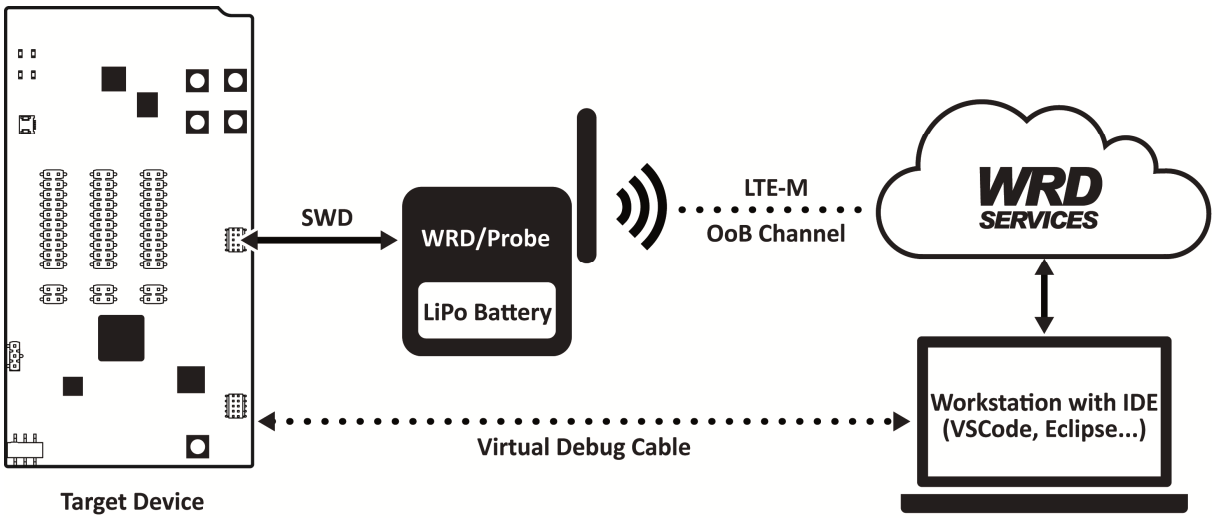


Figure 1: Usage of the WRD/Probe

1.1 Checklist

Please compare the content of your WRD/Probe package with the following checklist.

- ✓ **1x WRD/Probe**
- ✓ **1x USB-C cable**
- ✓ **1x 10-pin Cortex-M adapter**
- ✓ **1x LTE antenna**
- ✓ **1x Jumper cable set**
- ✓ **4x Rubber pads**

If any item is missing or appears to be damaged, please contact SSV.

1.2 Required Equipment

To operate the WRD/Probe a workstation with following features is required:

- **Linux, macOS or Windows (version 10 or higher)**
- **an Internet connection**
- **a GDB client, e.g. an IDE like Eclipse or VSCode**
- **a web browser (as UI for the WRD/Client tool)**

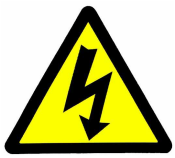
1.3 Document Conventions

Convention	Usage
bold	Important terms
`monospace`	Filenames, Pathnames, program code, command lines

Table 1: Conventions used in this document

2 SAFETY GUIDELINES

Please read the following safety guidelines carefully! In case of property or personal damage by not paying attention to this document and/or by incorrect handling, we do not assume liability. In such cases any warranty claim expires.



ATTENTION!

OBSERVE PRECAUTIONS FOR HANDLING – ELECTROSTATIC SENSITIVE DEVICE!

- **The device is for indoor use only!**
- **Do not expose the device to extreme temperatures, direct sunlight, extreme humidity or moisture. Avoid condensation at any time.**
- **Installation, repair or maintenance – especially opening the device! – must only be carried out by qualified personnel.**

3 BLOCK DIAGRAM

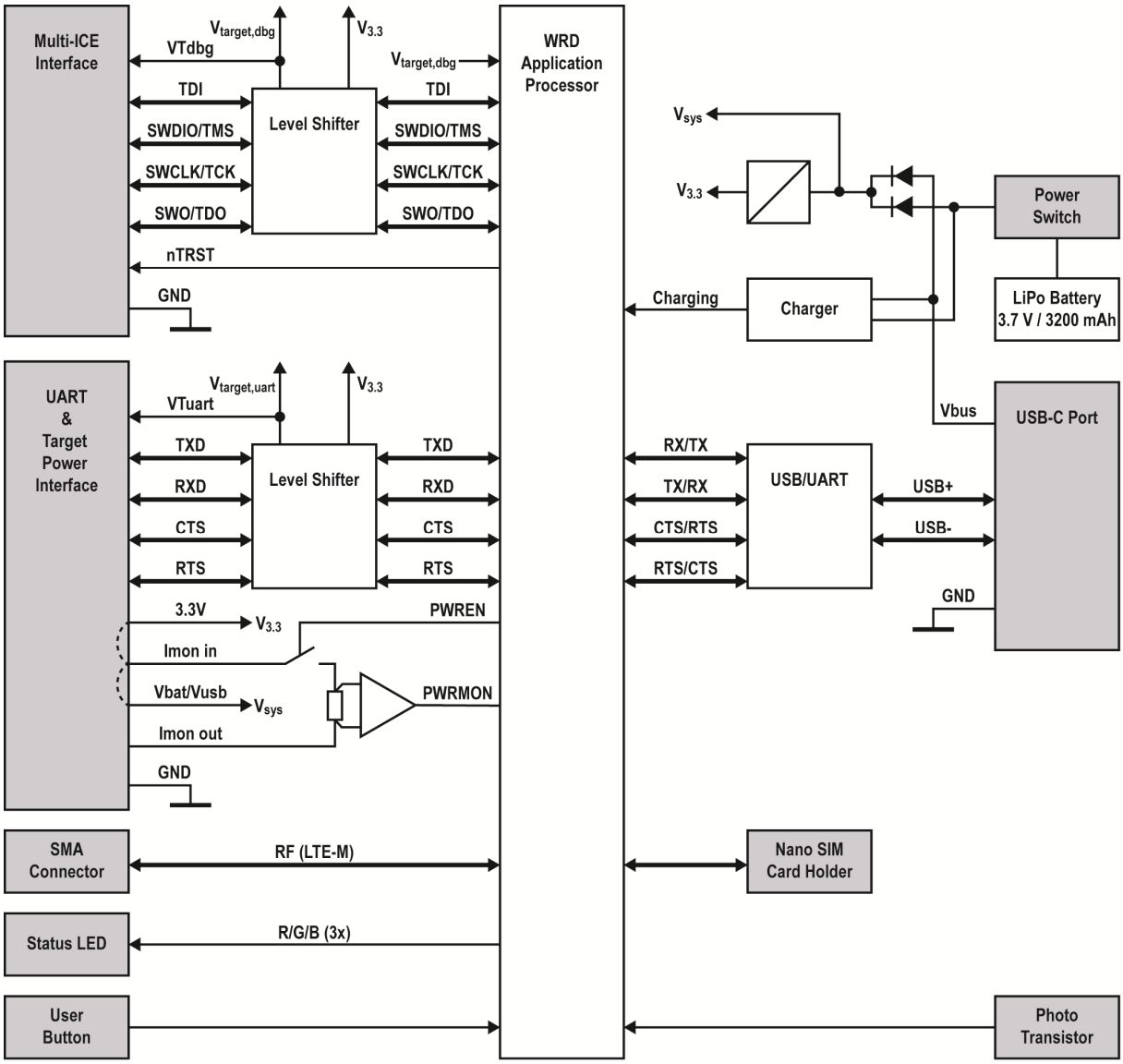


Figure 2: Block diagram of WRD/Probe

4 TECHNICAL DATA

Interfaces	
Antenna	1x SMA connector for LTE antenna
LTE-M modem	Transfer rates: 1 Mbps peak download, 1 Mbps peak upload Frequency bands: B1-B5/B8/B12/B13/B18-B20/B25-B26/B28 and B66 Frequency range: 700-2200 MHz Output power: up to 23 dBm RX sensitivity: -108 dBm Mode: HD-FDD
SIM	1x Nano SIM card holder (internal)
Serial ports	1x 10-pin UART with power monitoring 1x 20-pin Multi-ICE compatible for JTAG & SWD
USB	1x USB-C
Photo transistor	1x
Special Functions	
RTC	1x Real Time Clock
Watchdog	1x Timer watchdog (hardware-based, software-configurable)
Security	Handshake via flicker code Transport channel encryption with TLS1.2 End-to-end encryption with AES-128-CCM
Debugging	Internal GDBServer supports MCU's from Nordic, STM, NXP, Microchip, Raspberry Pi, Silicon Labs
Protocols	GDB
Wireless connectivity	Pre-installed MVNO IoT SIM card with 500 MB traffic for 5 years
Displays / Control Elements	
Status LED	1x RGB
User button	1x
Power switch	1x
Electrical Characteristics	
Power supply	Lithium polymer (LiPo) battery with 3.7 VDC, 3200 mAh (up to 12 months of battery life without recharging)
Supply current	Appr. 300 µA (standby)
Mechanical Characteristics	
Protection class	IP20
Mass	Appr. 440 g (with antenna)
Dimensions	130 x 105 x 35 mm (without antenna)
Operating temperature	0 .. 40 °C
Standards and Certifications	
EMC	CE
Environmental standards	RoHS, WEEE

5 OVERVIEW

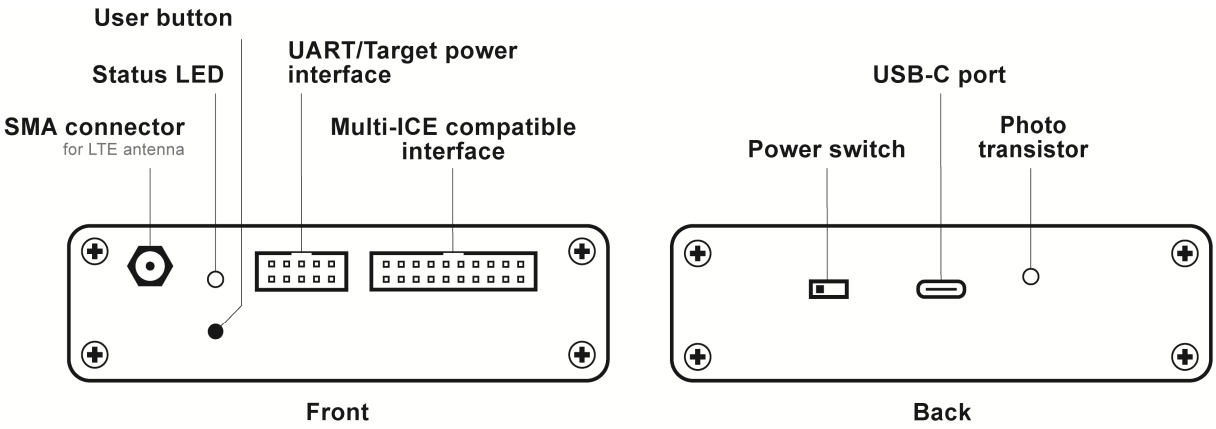
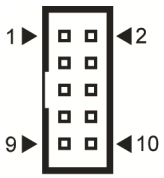


Figure 3: Overview of WRD/Probe

6 PINOUTS

6.1 UART & Target Power Interface

This interface features a UART with handshaking signals (TXD/RXD/CTS/RTS).



Pin	Name	Type	Function
1	RTS	Output	Request-to-Send
2	CTS	Input	Clear-to-Send
3	TXD	Output	Transmit Data
4	RXD	Input	Receive Data
5	VTuart	Input	Voltage reference in the range of 1.8 V..3.3 V The UART interface can be disabled by the target by pulling VTuart to GND
6	GND	---	Ground
7	3.3V	Output	3.3 VDC Power Supply
8	Imon out	Output	Output for target current measurement
9	Imon in	Input	Input for target current measurement
10	Vbat/Vusb	Output	Target power supply (3.3 V..5.5 V)

Table 2: Pinout UART interface

The target can be power-cycled with an internal switch between **Imon in** and **Imon out**.

6.1.1 Target Power Supply Modes

By setting a jumper one of the following modes can be used, to supply the target.

Independent Power Supply
Set a jumper on **VTuart** and **3.3 V** to power the UART interface independently from the target's voltage.

The internal 3.3 V is used to power the output of the UART interface, hence it'll run on 3.3 V IO voltage.

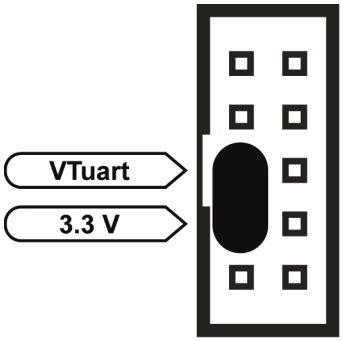


Figure 4: Jumper setting for independent power supply

3.3 V Power Supply
Set a jumper on **3.3 V** and **Imon in**. The target is powered with 3.3 V provided by the WRD/Probe by connecting it to the **Imon out** pin.

If the UART is used, connect **VTuart** to the target's IO voltage.

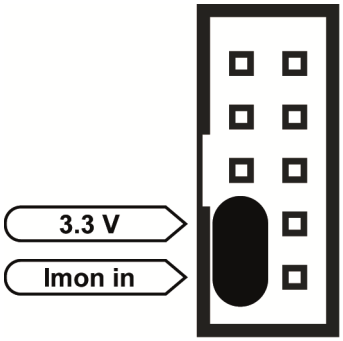


Figure 5: Jumper setting for 3.3 V power supply

Vbat/Vusb Power Supply
Set a jumper on **Imon in** and **Vbat/Vusb**. The target is powered by the WRD/Probe's battery or the USB 5 V by connecting it to the **Imon out** terminal.

If the UART should be used, connect **VTuart** to the target's IO voltage.

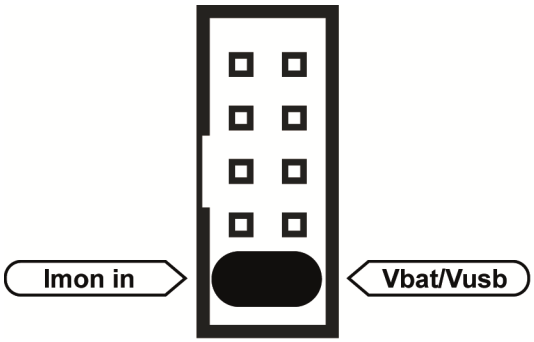


Figure 6: Jumper setting for Vbat/Vusb power supply

6.1.2 Absolute Maximum Ratings

Over operating free-air temperature range (unless otherwise noted)*.

Pins	Quantity	Min.	Typ.	Max.	Unit
Current Sensing					
Imon,in	Input Voltage	0.0		6.0	V
	Input Current	0.0		1.5	A
Power Supply					
3.3V & Vbat/Vusb	Output Current			0.5	A
Reference Voltages					
VTuart	Input Voltage	-0.5		3.6	V
UART I/O Signals					
RXD & TXD & RTS & CTS	Input Voltage	-0.5		VTuart+0.5	V
	I/O Current			±25	mA

Table 3: UART & target power interface absolute maximum ratings

* Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under E*lectrical Characteristics* (chapter 6.1.3). Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

6.1.3 Electrical Characteristics

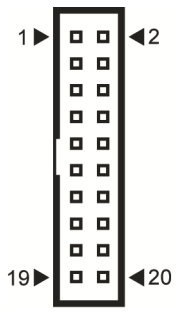
Over operating free-air temperature range (unless otherwise noted).

Pins	Quantity	Min.	Typ.	Max.	Unit
Current Sensing					
Imon,in	Input Voltage	0.0		5.5	V
	Input Current	0.0		0.5	A
	Shunt Resistance		0.6		Ω
Power Supply					
3.3V & Vbat/Vusb	Output Current			0.5	A
Reference Voltages					
VTuart	Input Voltage	0.0		3.3	V
UART I/O Signals					
RXD & TXD & RTS & CTS	Input Voltage	0.0		VTuart	V
	I/O Current			±20	mA
	Pull-up to VTuart Resistance		10		kΩ
	High-Level output voltage	VTuart*0.75			V
	Low-Level output voltage			0.4	V
	High-Level input voltage	VTuart-0.4		VTuart	V
	Low-Level input voltage	0.0		0.15	V

Table 4: UART & target power interface electrical characteristics

6.2 Multi-ICE Interface

This interface features **SWD** and **JTAG** interface and is compatible to the widely-used **Segger debugger pinout**.



Pin	Name	Type	Function
1	VTdbg	Input	Voltage reference in the range of 1.8 V..3.3 V The debug interface can be disabled by the target by pulling VTdbg to GND
2	---	---	Not Connected
3	nTRST	Output	Target Reset
4	GND	---	Ground
5	TDI	Input	Test Data Input
6	GND	---	Ground
7	SWDIO/TMS	I/O	Serial Wire Debug Input/Output / Test Mode Select
8	GND	---	Ground
9	SWCLK/TCK	Output	Serial Wire Clock / Test Clock
10	GND	---	Ground
11	---	---	Not Connected
12	GND	---	Ground
13	SWO/TDO	Output	Serial Wire Output / Test Data Output
14	GND	---	Ground
15	RESET	Output	Reset
16	GND	---	Ground
17	---	---	Not Connected
18	GND	---	Ground
19	---	---	Not Connected
20	GND	---	Ground

Table 5: Pinout Multi-ICE interface

6.2.1 Absolute Maximum Ratings

Over operating free-air temperature range (unless otherwise noted)*.

Pins	Quantity	Min.	Typ.	Max.	Unit
Reference Voltages					
VTdbg	Input Voltage	-0.5		3.6	V
Debug Open-Drain Signals					
RESET & nTRST	Input Voltage Current	-0.5		6.0 100	V mA
Debug I/O Signals					
SWO/TDO & SWCLK/TCK & SWDIO/TMS & TDI	Input Voltage I/O Current	-0.5		VTdbg+0.5 ±25	V mA

Table 6: Multi-ICE interface absolute maximum ratings

* Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under E*lectrical Characteristics* (chapter 6.2.2). Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

6.2.2 Electrical Characteristics

Over operating free-air temperature range (unless otherwise noted)*.

Pins	Quantity	Min.	Typ.	Max.	Unit
Reference Voltages					
VTdbg	Input Voltage	0.0		3.3	V
Debug I/O Signals					
SWO/TDO & SWCLK/TCK & SWDIO/TMS & TDI	Input Voltage I/O Current Pull-up to VTdbg Resistance High-Level output voltage Low-Level output voltage High-Level input voltage Low-Level input voltage	0.0 VTdbg * 0.75 VTdbg-0.4V 0.0	 10 	VTdbg ±20 0.4 VTdbg 0.15	V mA kΩ V V V V
Debug Open-Drain Signals					
RESET & nTRST	Input Voltage Input Current Series Resistance	0.0	 100	5.5 50	V mA Ω

Table 7: Multi-ICE interface electrical characteristics

6.3 USB-C Port

The USB-C port is used to charge the WRD/Probe's internal LiPo battery.

It can also be used to supply the target (please refer to **chapter 6.1.1**).

6.4 Photo Transistor

The photo transistor is used to read the flicker code on the screen generated from the WRD/Client tool for the pairing process between the workstation and the WRD/Probe.

7 CONTROL ELEMENTS

7.1 Status LED

A description of the various information indicated by the status LED can be found in the “First steps” document in the following GitHub repository:

`https://github.com/SSV-embedded/WRD-Probe/`

7.2 User Button

Short button press: Waking up the WRD/Probe, sending telemetry data to the WRD/Client and displaying the LTE-M signal strength via the status LED.

4 second button press: Starting the pairing process.

7.3 Power Switch

 **Switch position left:** WRD/Probe on.

 **Switch position right:** WRD/Probe off.

8 EXPOSED INTERFACES & SERVICES

The exposed network interfaces and services listed here are delivered as part of the factory default state of the WRD/Probe.

8.1 Exposed Network Interfaces

- LTE-M interface of the WRD/Probe (without open ports)
- Internet of the WRD Services (WRD/Probe and WRD/Client connect to the WRD Services)
- Internet of the WRD/Client (ports will be opened on localhost when GDB server and/or UART bridge are enabled)

8.2 Exposed Services

- Proprietary relay-protocol via TLS1.2 between WRD/Probe (as client) and WRD Services (server port 912)
- Proprietary relay-protocol via TLS1.3 with Websockets between WRD/Client (as client) and WRD Services (server port 443)
- GDB server of the WRD/Client via TCP port 3210 ff.
- UART bridge endpoint at the WRD/Client via TCP port 3410 ff.

9 CALCULATE BATTERY LIFE

The effective battery life of the WRD/Probe mainly depends on two factors:

- **The operating mode of the WRD/Probe**
- **The power consumption of the connected target when it is supplied by the WRD/Probe.**

To determine the total power consumption, the following two values must be known:

- **The supply current of the WRD/Probe (SC_1)**
- **The supply current of the target (SC_2)**

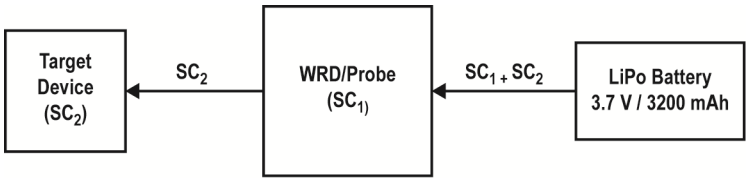


Figure 7: Composition of the total power consumption of the WRD/Probe

The supply current of the WRD/Probe (SC_1) depends on its operating mode as shown in **table 4**. The supply current of the target (SC_2) must be determined based on the technical data and/or by measurement.

Operating Mode	Average Supply Current
Standby	0.3 mA
GDBserver enabled	15 mA
UART bridge enabled	2.2 mA

Table 8: Required supply current of the WRD/Probe operating modes

The formula to calculate the battery lifetime is as follows:

Lifetime (in hours) = battery capacity (in Ah) / current consumption (in A).

Example
If the UART bridge is permanently enabled and the target is supplied by the WRD/Probe with an average supply current of 0.1 mA, the calculation is as follows:

Lifetime = 3200 mAh / 2.6 mA (0.3 + 2.2 + 0.1) = 3.2 Ah / 0.0026 A ≈ 1230 hours (51 days).

9.1 Charge Battery

To fully charge the battery of the WRD/Probe, use a **standard USB charger** (such as for a smartphone) and charge it for **appr. 12 hours.**

10 MECHANICAL DIMENSIONS

Dimensions without mounted antenna. All length dimensions have a tolerance of 0.5 mm.

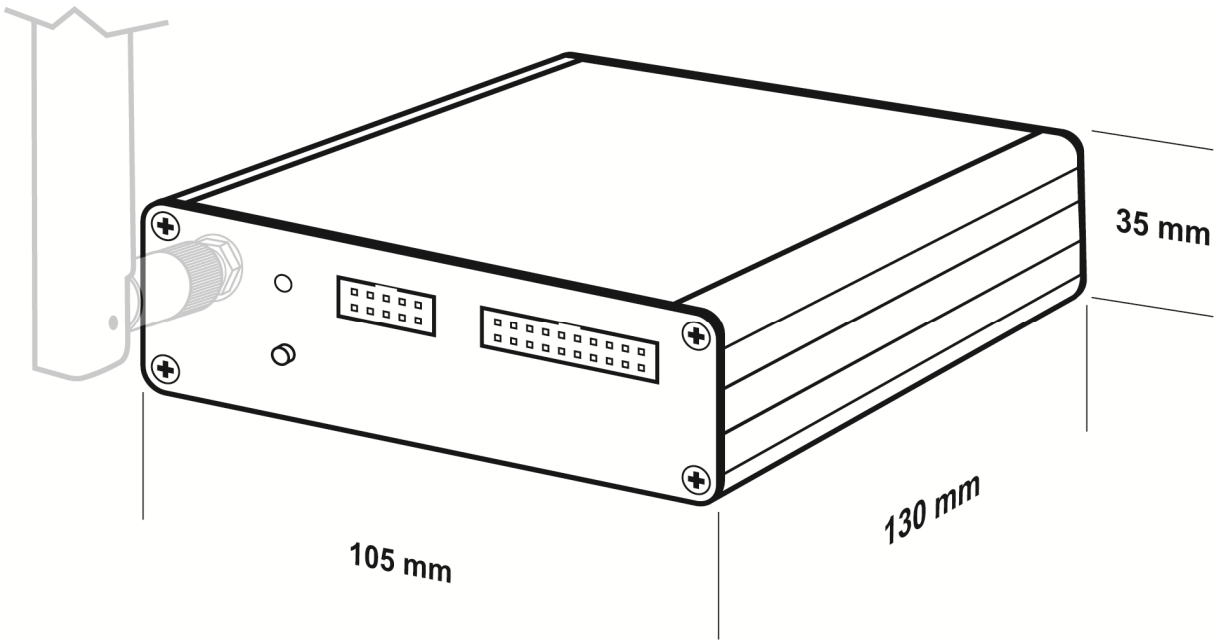


Figure 8: Mechanical dimensions of WRD/Probe

11 DISPOSAL & ENVIRONMENTAL INFORMATION

11.1 Disposal of the Product

This product is subject to **Directive 2012/19/EU on Waste Electrical and Electronic Equipment (WEEE)** and must not be disposed of as unsorted municipal waste.

The symbol of the crossed-out wheeled bin indicates that the product shall be collected separately at the end of its service life. Users are required to dispose of waste electrical and electronic equipment through designated collection facilities provided by local authorities or retailers. Proper disposal contributes to the prevention of potential environmental and public health risks and supports the recovery and recycling of materials.

11.2 Built-in Lithium-Polymer Battery – Safety and Disposal

This product contains a permanently integrated lithium-polymer rechargeable battery subject to **Regulation (EU) 2023/1542 concerning batteries and waste batteries**.

The battery is not intended to be removed or replaced by the end user. Removal may only be performed by qualified service personnel. The battery must not be disposed of in household waste. At the end of the product's service life, the complete device shall be returned to an appropriate collection facility for electrical and electronic equipment.

11.3 Safety Warnings – Lithium-Polymer Battery

- **Do not open, dismantle, crush, puncture, or deform the device.**
- **Do not expose the device to fire, excessive heat, or direct sunlight.**
- **Do not short-circuit the device or expose it to water or other liquids.**
- **Do not charge the device outside the specified operating temperature range.**

Risk of fire and explosion: Improper handling, mechanical damage, or exposure to high temperatures may result in fire or explosion.

Risk due to deep discharge: Prolonged storage in a fully discharged state may cause irreversible battery damage and may increase the risk of overheating or fire during subsequent charging.
Recharge the product periodically during extended storage in accordance with this manual.

If the device shows signs of swelling, overheating, leakage, unusual odor, or deformation, discontinue use immediately and place the device in a non-flammable area. Do not attempt to continue charging or operating the product.

Failure to comply with these instructions may result in hazardous conditions and void applicable warranty or liability claims to the extent permitted by law.

12 HELPFUL LITERATURE

- https://github.com/SSV-embedded/WRD-Probe/

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DOCUMENT HISTORY

Revision	Date	Remarks	Name	Review
1.0	2026-02-12	First version	WBU	JFI
1.1	2026-03-02	Added chapter 8 with information about exposed network interfaces and services	WBU	JFI